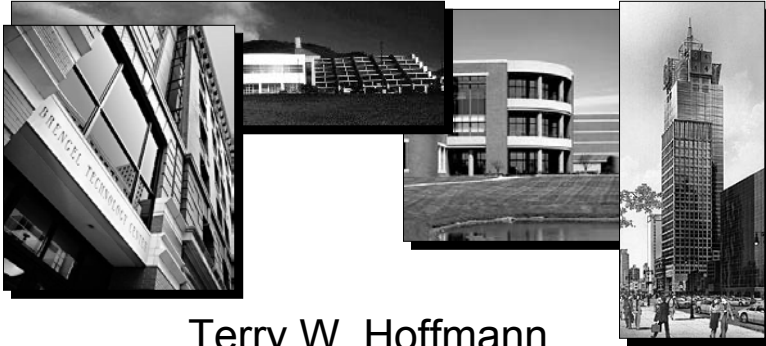


## Building Controls designed for Clean Energy and a Sustainable Future

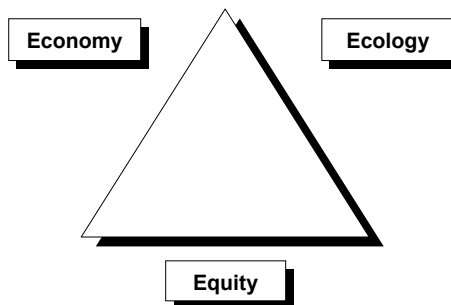


**Terry W. Hoffmann**

Director of Marketing  
Building Automation  
Johnson Controls, Inc.

## Classic Definition of Sustainability

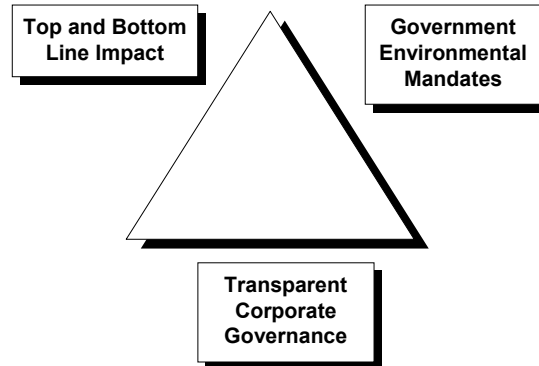
New Organizational Metric



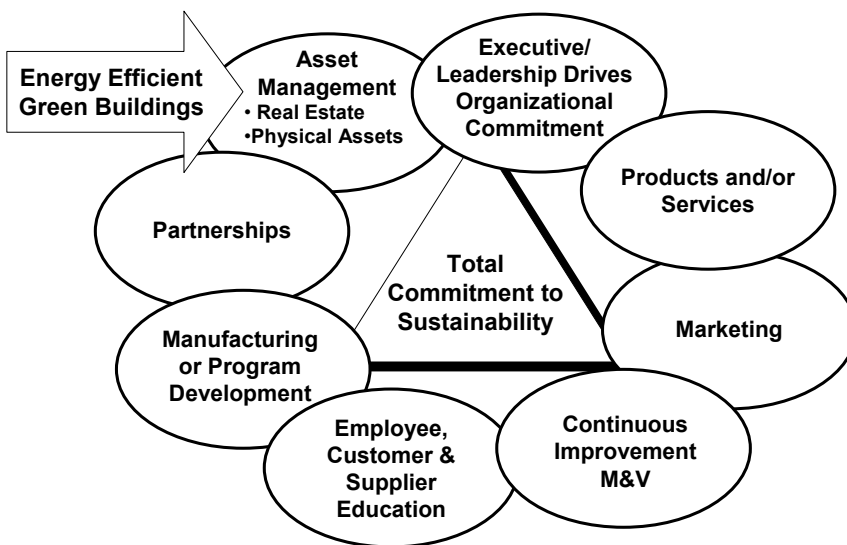
*Triple Bottom Line*

# Sustainable Business Practices

## Why Sustainability is Here to Stay



## Total Organizational Commitment to Sustainability



## Environmental Impact of Buildings

Americans spend as much as 90% of time indoors.

Buildings:

- **Consume almost 40% of all energy.**
- **Add 40% to atmospheric emissions.**
- **Use 68% of all electricity.**
- Use 12% freshwater, 88% potable water.
- Take up to 40% of the municipal solid waste stream.
- Exploit significant amounts of land.



## Energy Savings Actions

1990-2000

- Energy Cost Savings – \$16.7 billion
- Electric Energy Savings – 166 million MWh
- Electric Demand Reductions – 2,500 MW
- Carbon Dioxide Emissions Reduction 217 Million Tons
- Enough energy saved to power all California households for 2 years



## Total Energy Savings Actions

### 1990-2020

- \$95 billion in energy savings
- 981 million MWh in electric energy savings
- 6,000 MW in electric demand reduction (15 new 400 MW power plants)
- 5.3 billion MMBTU reduction in direct fuel use
- Total energy savings
  - 4% of Kyoto goals
  - Could power all California households for 13 years



## Additional Characteristics of Energy Efficient Green Buildings

- Optimal environmental and economic performance
- Increased efficiencies, saving time and resources
- Satisfying, productive, quality indoor spaces
- Whole-building design, construction, and operation over entire life cycle
- Fully integrated approach – teams, processes, systems



## Economic Benefits of Green Design

### Lower Construction Costs

- Reduced site preparation and landscaping
- Lower waste disposal costs by 50 to 98 percent

### Reduced Operating Costs

- Lower utility costs by 20 to 50 percent
- Reduced maintenance costs

### Higher Valuation of Building

- Rule of Thumb: divide reduction in annual operating costs by 10 percent to get increased value of building.
- Up to \$4 increased valuation for every \$1 spent.

## Economic Benefits of Green Design

### More Productive Environment

- Better tenant and worker attraction/retention
- Less absenteeism by 45 percent
- Higher productivity up to 16 percent

### Reduced Insurance and Risk of Liability

- Healthy occupants, greater occupant satisfaction
- Lower environmental impacts
- Streamlined regulatory approvals

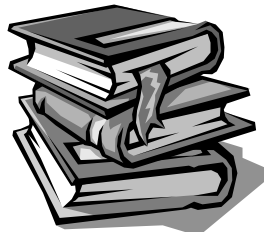
### Higher Visibility and Marketability

## What is a Control System?

- A control system consists of hardware and software that is designed, installed, commissioned and maintained to provide buildings, the people within them and the business processes they facilitate with:
  - Safety
  - Security
  - Productivity
  - Efficiency (sustainability)
  - Comfort (stress reduction)

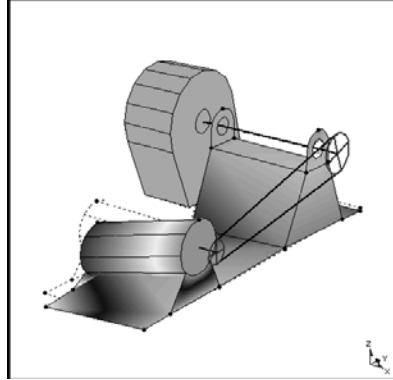
## What you Thought you'd Hear

- Near-optimal control solutions
- Advanced digital control
  - PRAC
  - P-Adaptive
- Process Modeling
- Predictive diagnostics
  - Equipment signatures
- Resource tracking



## Not to be Completely Outdone

- ODS (Operating Deflection Shape)
  - Vibration data applied to the 3-dimensional model
  - A movie file is created to show the movement at several different frequencies.



## Systems Requirements Today

- Less data...  
more usable information
- Ease of use
- Open systems and vendor independence
- “Web interface”
- Current technology, but protect my investment

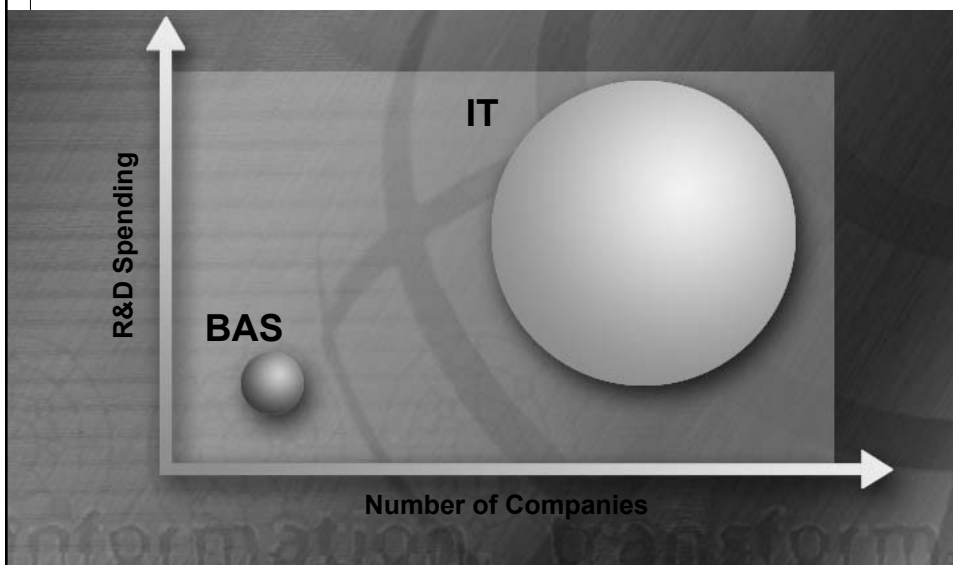


## System Requirements Tomorrow

- Less data, more information
- Ease of use
- Open systems and vendor independence
- “Enterprise interface”
  - Talk to any system, any time
  - Contribute to lowest cost of ownership
- Appropriate technology “built in”



## IT vs BAS R&D Spending





## Convergence

- Systems that communicate with each other
- Systems that talk to enterprise applications
- Systems that talk to us anywhere, anytime
  - Across the Web
  - To our portable devices
  - In a format we can use
  - Regardless of who we are



## A New Systems Philosophy

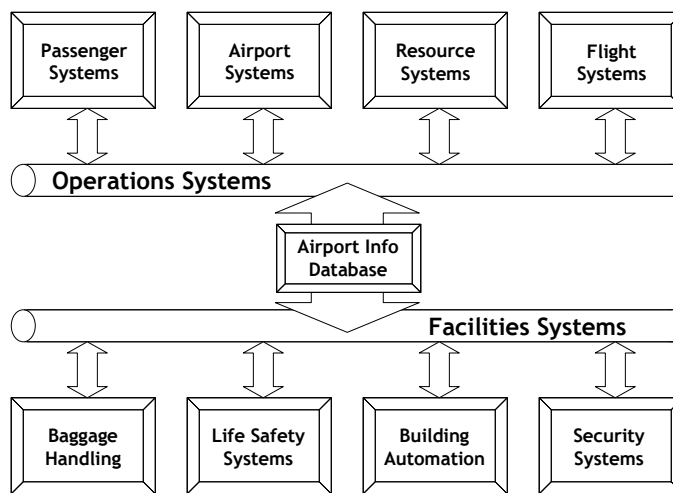
Before	Today	Vision
Workstation Based	Client / Server	Networked Computing
Supervisory Controller	Automation Engine	More capability at the core
Proprietary Operating Systems	Open/Standard OS	Infrastructure Compatibility
Mfg designed Field Protocols	Open/Standard Protocols	Device Interoperability
Proprietary Data Storage	Open/Standard Data Storage	Data Interoperability
Physical Plant Component	IT Infrastructure Component	Information: Ubiquity

## Organizational Cooperation

- Design the IT infrastructure as a key component of the facility
- “You can’t lead if your infrastructure won’t follow”
- Establish dialog with IT resulting in:
  - Understanding of mutual needs
  - Doing what is best for the organization
  - Usability and access
  - Security issues resolution



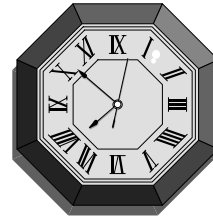
## The Facility and the Enterprise Airport Example



## Changes in Attitude

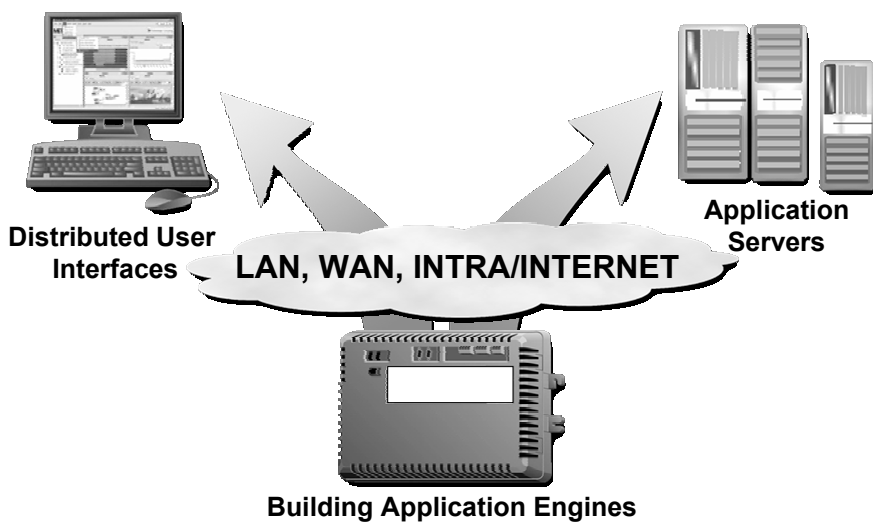
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- Building Automation Systems (BAS)
  - Energy Management and Control Systems
  - Building Management and Control Systems
  - A vital piece of the Enterprise Management System
- One Big Time Clock?
  - Lack of attention to advanced features
  - Ability to communicate information:
    - People
    - Systems



## Enabling Technologies Application Engines

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## Enabling Technologies

### Application Engines & Servers

- Advanced Functionality
  - User Interface (UI)
  - Data server
  - Programming tools
- Ease of Use
  - Beyond web pages
  - Automatic Web interface
- Connectivity standards
  - Deliver the benefits of convergence
    - SOAP
    - XML

## Standard Operating Systems

### A Change in Direction

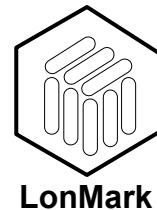
- Current products are based on control industry technology
- Evolution to standard Operating Systems adds advanced IT in the physical infrastructure to deliver benefits



## Key Technologies Standard Protocols

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- Integrated systems must provide function & benefits
- BACnet and LonMark are not enough
- BACnet and LonWorks are both valuable tools in certain situations but neither is the best single answer for most
- Supplement with ModBus, DHP, DALI

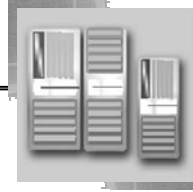


## Web Services?

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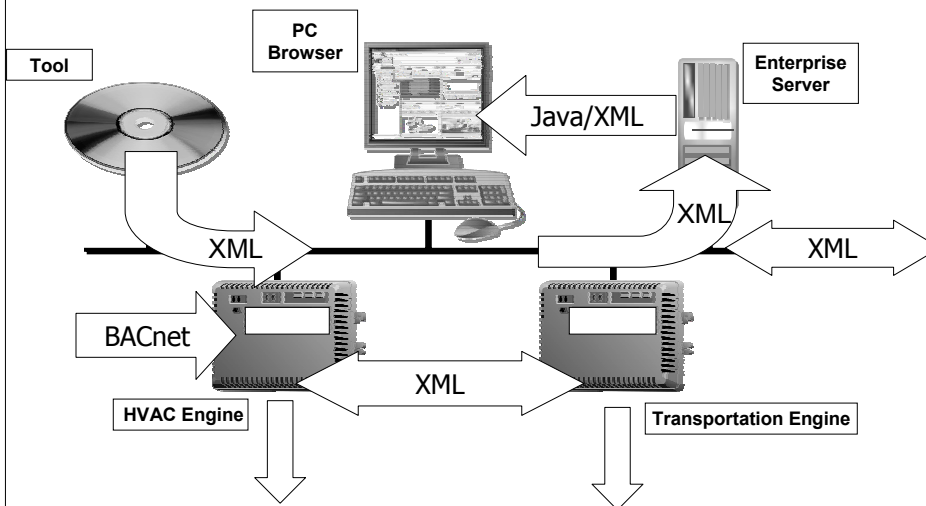
- XML Web services are the fundamental building block in the move to distributed computing on the Enterprise network
- XML Web services extend the World Wide Web infrastructure to provide the means for hardware and software to connect to other applications (M to M)
- XML Web services use existing communications protocols for transportation (SOAP)
- Efforts are in place now to standardize the web service interface to building systems

## Enabling Technologies Open Data Storage



- Open DataBase Connectivity (ODBC)
  - Data definition
- Structured Query Language (SQL)
  - Data exchange language
- eXtensible Markup Language (XML)
- Open, proprietary standards
  - Oracle

## System Communication



## Design Goals

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- Systems that communicate with each other Via standards
- Systems that talk to enterprise applications
- Systems that talk to us anywhere
- Systems that are easy to learn and operate
- Systems that leverage technology
  - Leading edge
  - Not bleeding edge

## Design Guidelines

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- Connected does not mean tethered
  - Use copper as a last resort
  - Coverage must be complete
- Small is better
  - Mobile devices combine power and convenience
  - Use standard operating environments
- Monogamy isn't always desirable
- Share information (guard data)
- Choose static (in place) over dynamic
- Don't just do something; sit there (listen)

## Design Process

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- Begin before the beginning
- Use left to right thinking
- IT has a place at the table along with the other trades (electrical, plumbing, mechanical)
  - Could be “technology contractor”
- Technology should be value engineered in at the beginning, not out at the end
- Look TCO, not TIC or even TOC
- Functionality trumps everything

## Summary

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- The controls end game is changing
  - From facility to enterprise
  - Closed to open (proprietary to standard)
  - Private to public
  - Separate to shared
- The development process must change
- Technology is second only to functionality
  - Appropriate
  - Applied correctly



## What About Energy

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- Now we have the infrastructure
  - To share information that is easily interpreted
  - To develop software that is transportable
  - That leverages the IT investments we make
  - To enable true enterprise wide energy applications
    - Enterprise wide metering and billing
    - Energy modeling and forecasting
    - “What if” scenarios
    - Conformance and impact statements

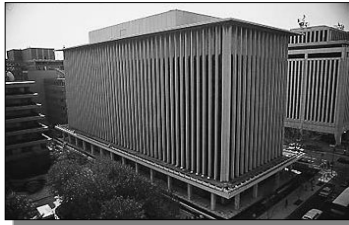
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## Case Studies

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## LEED Point Categories

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- Sustainable Sites
- Materials & Resources
- Water Efficiency
- Energy & Atmosphere
- Indoor Environmental Quality
- Innovation



Questions ?

